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A HIGH-TEMPERRATURE VACUUM FURNACE FOR MELTING QUARTZ GLASS

R. Sh. Nasyrov,[1] A. G. Korablev,[1] A. R. Shakirov,[1] and V. N. Bykov[1]

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An economical high-temperature unit for quartz glass test melts was created based on a vacuum resistance furnace. To update the melting chamber of the standard furnace, a heating unit with a working temperature of up to 2200°C was developed and manufactured; it consists of a tungsten heater and molybdenum heat shields which allow melting small blocks of quartz glass. The updated furnace is used to evaluate the technological properties of natural quartz from different deposits.

Rapid and economical test melts which must provide small blocks of glass weighing up to hundreds of grams for determining the physicochemical properties of the melted glasses are necessary for evaluating the manufacturing properties of natural quartz as feedstock for synthesis of high-quality quartz glass.

The problem was solved by updating the melting chamber in the SNVÉ-1,31/16-IZ-UKhL 4.1 vacuum resistance furnace. In the standard execution, a limiting temperature of 1600°C at power consumption of up to 20 kW is attained in the horizontal chamber of this furnace. Providing the higher temperatures required for melting quartz glass is restricted by the design features of the tungsten heaters.

[1] Institute of Mineralogy, Ural Branch, Russian Academy of Sciences, Ekaterinburg, Russia.

We developed and manufactured a heating unit consisting of a tungsten heater and heat shields (Fig. 1) which ensured a temperature of up to 2200°C in a 1000 cm^3 working volume. The height of the heater is 110 mm and the diameter is 100 mm. The heater consists of 24 tungsten rods 2 mm in diameter grouped by 12 in two molybdenum half-rings and successively connected with a molybdenum ring. The multilayer heat shield is made of molybdenum foil and consists of two semicylinders and top and bottom lids.

In certifying the melting chamber, it was found that the axial and radial temperature gradients in the working volume of the heating unit do not exceed 7 K/cm at 1800°C. The power consumption of the high-temperature unit is half the standard consumption of the SNVÉ-1,31/16-IZ-UKhL 4.1 electric furnace and is equal to 9 kW at heater current strength of up to 1100 A. The rarefaction in the melting chamber is 6.5×10^{-4} Pa (5×10 mm Hg).

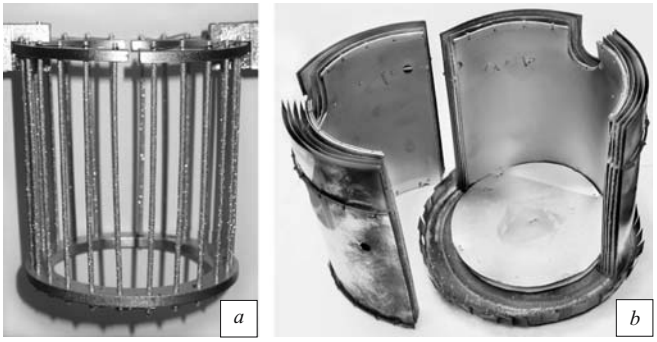

Fig. 1. Vacuum furnace heating elements: *a*) heater; *b*) heat shield.

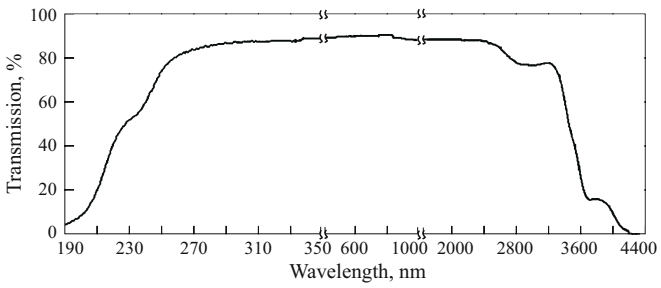

Fig. 2. Transmission spectrum in the UV, visible, and IR region for melted quartz glass (10 mm thick, with no correction for reflection).

To prevent contamination of the quartz glass, melting is conducted in sealed quartz beakers (KI glass) 50 mm in diameter which are in turn placed in a specially fabricated cylindrical molybdenum foil crucible.

The transmission of quartz glass melted from quartz concentrate from vein No. 175 in the Kyshtym deposit is shown in Fig. 2. More than 50 experimental quartz glass melts were conducted in this high-temperature unit and the melting chamber exhibited high efficiency and economy during use.

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